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[*Numerous complaints reach us of delay in receiving "Science" through the mails. It appears that it frequently takes a week for the paper to reach Illinois, for instance. This is owing to the small allowance of funds to the New York Post-Office, which prevents the employment of a sufficient force and compels the present force to work in decidedly over-crowded quarters.*]

THE PEDIGREE OF THE LETTER Y.

BY CANON ISAAC TAYLOR, LITT.D., YORK, ENGLAND.

IT is commonly asserted that our letter *y* is the lineal descendant of the Roman Y, which in the time of Cicero was borrowed from the Greek alphabet to represent *upsilon* in the transliteration of Greek names. This, however, is a mistake, as will be seen by tracing the history of the letter. It is only when *y* is used, as the Romans used it, as a vowel to transliterate *upsilon* in loan-words (either direct from the Greek or indirectly through Latin or French), such as *hyperbola*, *hydrostatics*, *hypocrite*, *tyrant*, or *myrtle*, that our *y* represents the Roman Y and the Greek *upsilon*. In the great majority of cases the English *y* is a semi-consonant corresponding in value to the Continental *j*, as in *young*, *yea*, *year*, *Yenisei*, *Yakut*, which in German are spelt *jung*, *ja*, *jahr*, *Jenisei*, *Jakut*. Along with the other Roman letters, the letter Y was adopted by the Anglo-Saxons from the Latin alphabet, with a value approximating to that of *i*, and hence the *y* in Anglo Saxon words has usually become *i* in modern English, or has lapsed into the neutral vowel, as in the words, *fyr*, *fyst*, *hyd*, *hyf*, *brycg*, *ynce*, *hyll*, *flyht*, *yfel*, and *wyrm*, which are now written *fire*, *fist*, *hide*, *hive*, *bridge*, *inch*, *hill*, *flight*, *evil*, and *worm*. In fact, there is not a single lineal descendant of the Anglo-Saxon *y* now in existence. The letter *y* in modern English words is, curiously enough, not a *y* at all, but a lineal descendant of the Anglo-Saxon *g*, which was the Roman G, evolved by the Romans out of an earlier C. This Anglo-Saxon *g* split into two sounds, retaining the old hard sound before or after the back vowels *a*, *o*, and *u*, as in *go*, *dog*, *gold*, *gum*, while before or after the front vowels *e* and *i* it weakened into a palatal semi-vowel; the words *ge*, *gese*, *gea*, *git*, and *gear*, becoming *ye*, *yes*, *yea*, *yet*, and *year*. A symbol which has acquired two values is frequently differentiated into two forms, thus *i* and *j*, *u* and *v* have come to denote respectively the vocalic and semi-consonantal sounds of the same primitive symbol. This happened with the values of *g*. The Anglo-Saxon form ȝ came to be appropriated for the weakened sound, and the Caroline or Continental form *g* was used for the original stopped sound. In Middle English MSS., we have the two forms side by side, written ȝ and *g*. At the time of the invention of printing, this weakened *g*, written ȝ, had become almost identical in form with *y*, and accordingly printers used *y* to express it, while in Scotland a *z* in black letter (ȝ) was used for the weakened *g*, and in old Scotch books we fine *yet* printed as *zit*, and *year* as *zeir*, not that these words were pronounced with a *z*, but *z* was used for ȝ, as *y* was in England; just we write *viz* for *videlicet*, where the *z* is not the sibilant, but merely an old ligature for *et*, *videlicet* being formerly written *videlicȝ*, in the same way as *libet* was written *libȝ*. So also the final *y*, so common in English words, is really the descendant of the final *ig*, equally common in Anglo-Saxon; *many*, *busy*, *any*, *greedy*, *silly*, *honey*, *holy*, and *day* being the Anglo-Saxon words *manig*, *bysig*, *ænig*, *grædig*, *sælig*, *honig*, *halig*, and *dæg*. This final *y* is so common a termination in English that, owing to analogy, it has replaced the old termination *ie* in other words, as in *academy*, *anatomy*, *homily*, and *irony*, where it represents the Greek *ia*, or in *jolly* and *tardy*, where it represents the French *if*. In *by* and *my* it has been introduced from analogy with words such as *dry*, *fly*, *sky*, where the *y* is really the weakened *g*. It will be objected that in certain words, such as "young" and "yard," an Anglo-Saxon *g* has become *y* before back vowels, but this fact is really only a confirmation of the rule, as in such cases the front vowel which modified the *g* has been lost, "young" being from the Anglo-Saxon *geong*, and "yard" from *geard*.

In the neo-Latin languages the same weakening of *g* before front vowels took place, but duplicate forms of the letter not being available to denote the two sounds, *g* represents both sounds, as in the case of the Italial words *gente* and *gallo*, or the French *géant* and *gôut*, or else the *g* was replaced by *j*, as in *jouir*, from the Latin *gaudere*.

INSTINCT.

BY C. F. AMERY.

IT is now universally recognized that animals possess intelligence. The evidences on this head are too patent for dispute; but, like the guinea of the Primrose girls, it is supposed to be employed only in extraordinary emergencies. All the text-books on comparative psychology assume that all the ordinary pursuits of animals are instinctive, by which is implied automatic and mechanical; but whether instincts are to be regarded as impulses or as guides to action, or whether the activities are themselves instincts, is nowhere clearly defined in the text-books I have consulted. I purpose, in the present paper, to define the nature of instinct, and to indicate its place and the importance of its functions in the general economy of animal life.

The only satisfactory course of procedure is, first to collect and array the facts, and as man himself presents abundant illustration of all the psychological activities exercised in the animal kingdom, we cannot do better than examine the facts and study the nature and functions of instinct as exemplified in our own persons.

What then is instinct?

All the functions of the human organism and all the activities of life are classifiable under three heads — the mechanical, the reflex, and the intelligent.

The mechanical are the fundamental continuous processes of digestion, assimilation, circulation, secretion, and respiration. All these processes are performed unconsciously and involuntarily excepting respiration, which is performed sub-consciously and is to a small extent under the control of the will.

The reflex activities are automatic responses of the neuro-muscular organism to the stimulus sensations. They begin and end in the organism. In man, as in other animals, they are due to secretions in the system, to contact with external objects, or to special periodical or occasional conditions of the organism. They are all performed consciously by man, and are all susceptible of being brought more or less under the control of the will. The most common reflex activities are laughing, crying, sucking, masticating, swallowing, voiding the fœces and urine, coughing, sneezing, withdrawal from contact with objects, purposeless bodily exercise, etc. Laughing and crying may result from sensation, but they are sometimes reflex activities of the brain, originating in ideas.

Intelligent activities result from the perception of objects, their properties, and relations. Every effort for adjustment of the organism to external conditions apprehended through the senses is

intelligent. Touch is the connecting link between sensation and sense.

Instincts are not activities, but impulses to action. They are due to the sensations being transmitted from their several local seats to the brain, where they present themselves as cravings, desires, appetites, imperatively calling for relief. They prompt to two classes of activities, those which can be performed by reflex action of the organism, and those which require the adoption of intelligent means for their satisfaction. Hunger is a type of the latter, the impulse to void the fœces and urine may be taken as a type of the former. Among the most important instincts are the craving for food, the sexual, and the maternal instincts.

Instinct impels to action, but does not guide to its performance. It appeals to the mind like a squalling infant to its parents. If reflex action will appease it, it is simply a function of the will; if intelligent measures are required, it is the function of the intellect to adopt them. I may emphasize here, as bearing on what I shall urge later, that the most important instincts originate in the local action of proper secretions, as the contents of stomach and bladder, the gastric juice, the spermatorrhœal and lacteal secretions, etc., all provoking impulses essential to the preservation of the individual and the species; and no less important to man's intellectual development is the impulse to purposeless activity generated by the waste particles of the tissues on their way to the skin. Every psychological phenomenon has its physical basis, a self-evident proposition occasionally lost sight of in the discussion of instinct.

Up to this point it will be generally admitted that the vertebrate animals and higher insects are physiologically and psychologically close counterparts of man, the one essential difference being that their perceptions are all limited in range, while man's perceptions embrace the universe. The distinction appears to arise when we approach the subject of the inherited perceptions and working capacities. Many of the lower animals exhibit special inherited capacity involving clear perceptions such as man rarely exhibits without experience or instruction; and by almost common consent these special capacities and perceptions, although recognizedly the inheritance of the active intelligence of the species, are classed as "instincts." The classification which groups these psychological phenomena with impulses generated by secretions, is hardly a scientific one. Moreover, the accepted theory assumes that the species of so-called mental automatism exhibited, implies less intelligence than was displayed by the early parents of the stock in reaching the attained level of capacity, a view certainly not borne out by any degeneration of the brain; and, last, the advocates of the theory appear entirely to forget how much dexterity of brain and hand man has acquired by heredity. But before entering on this subject I want to make a few remarks on the function and importance of instinct in the economy of life.

Instinct is the schoolmaster of the intellect. Primitive man, looking around on his environment, would hardly have acquired a single perception of the properties and relations of objects, unless spurred to investigation by his instincts. The instinctive craving for daily food spurred his faculties to the discrimination of all the food substances presented to his senses. He soon acquired familiarity with the characters of every fruit, grain, root, etc., capable of appeasing his hunger, and with the characters and habits of all living creatures around him. In these matters he was fairly rivalled by the lower animals which, prompted by the same instinct of hunger and sense of danger, had their perceptive faculties equally aroused to the character of every thing that could be used as food by them, or that imperilled their lives. Man's hand was the wonderful organ which soon raised him above the intellectual level of the beasts; this, too, would have been useless to him but for the impulse to purposeless activity which besets him from childhood. Subject to this instinct he was, in common with his less-gifted fellow-creatures, under the imperative necessity of exercising every set of muscles and testing every organ in every direction of which it was capable of being used. In these exercises man at once became a being apart, by virtue of his hand. He was impelled to lay hold of every thing he saw, within the compass of his grasp, and whatever he laid hold of aroused his perception of its properties. He hurled stones and wielded sticks, revelling in the mere enjoyment of his powers, until gradually he acquired that experience of the properties of sticks and stones which suggested their application to the ever-present necessity of providing food. It must not be supposed that he advanced to a single idea without experience. He must have experienced the force of a blow from stick or stone, perhaps many times, before he conceived the idea of utilizing them as weapons of offence or defence. Once started on his path of progress, his daily experience constantly added to his stock of perceptions of the properties, and later of the possible uses, to which he could apply the objects he actually handled. There came a time in the progress of the race when man learned to reason from the known to the unknown, but primitive man was slow in developing this faculty. As regards every thing which affects their personal preservation and food supply, all the evidences point to the conclusion that the perceptions and reasoning powers of other animals are as keen and sure as savage man's; but, wanting the hand and the accompanying wider range of perceptions, their progress was limited to a narrower field. Only one mammal, the beaver, has developed a high constructive capacity. Why is this?

Remembering what was above said about instincts originating in secretions, it suggests itself that the castor of the beaver may possibly furnish a special impulse to activity in a prescribed direction, but this is not necessary to explain the dam- and castle-building talent of the beaver. The materials used in construction were the waste products of his food which he had to manipulate under conditions which compelled his attention to such of their properties as he utilizes. By taking them to the mouth of his hole, and floating them off when the water was low, he dammed the stream and raised the water to his hole. In arranging them about his hole to make room temporarily, his perceptions were trained in the direction of castle-building. Given the beavers primitive habits and the suitable environment, the direction of his evolution was as much a matter of constitutional necessity as man's. Fewer faculties were called into requisition in his case, but these concentrated on special labors attained greater natural facility of application, this added facility becoming in time constitutional in the species.

The wonderful constructive powers of insects have been developed subject to the same law, but for the most part these creatures enjoy special facilities for the development of their special capacities. They not only have special instincts due to special secretions, but in these secretions they have the materials of construction. The thread of the spider and silkworm, the wax of the bee, the viscid, and other special secretions of a hundred other insects, are all materials which would not excite their attention if they existed apart from themselves, but being under the daily necessity of manipulating them and being under a constitutional necessity of manipulating them in certain ways determined by the structure of their brain and manipulating organs, the species is forced to a perception of the uses they subserve, and are educated by experience to the point of engaging in their manipulation intelligently and with design. And just as the hand has played an important part in the evolution of man's intellectual faculties, so have the special secretions and special organs of insects necessarily produced like results. Their field of performance is limited in direction, but within their prescribed limits it is not unreasonable to suppose that they surpass man in the clearness of their perceptions. Within the field of their special activities they do not reason, they know. They reason only in emergencies.

This brings us to the final point and apparently vast distinction between the achievements of men and insects; and the arguments which apply here will hold good in considering the special aptitudes of creatures in other classes. The insects have inherited aptitudes for performing their special tasks without experience or instruction, ergo, it is argued, they are automatic, instinctive.

First with regard to the term instinctive, let us repeat here, the impulses generated by their special secretions prompt in all cases to the voidance of these secretions, but they go no further; the application of the voided material or its mixture into mortar

as with the white ant and mud-wasp are the results of intelligent observation and experience.

But it has become automatic! Brain and manipulating organs fulfil their allotted task without experience and instruction!

Here the parallelism with man is certainly no longer perfect; there is a divergence, but a divergence due only to the same laws acting on two sets of modified conditions. Man has developed by radiation in ever-widening circles and is still in course of an all-round development. The insect has developed along a narrow line and has reached the limit of his capacity, but that limit surpasses man's utmost attainments, both in clearness of perception without intellectual effort, and in facility of execution. The knowledge and capacity of execution gained by observation and experience have become constitutional. Man, in spite of the great breadth of his intellectual range, does occasionally reach something like the inherited clearness of perception and facility of execution of the insect, at special points of the circle; as, for example, in the inherited musical powers of a Mozart and other born composers, who have been capable of composing as automatically as the bee makes its cell; and I assume for both a similar intellectual gratification in the exercise of their powers. Look again at the born arithmeticians and mathematicians; or, again, at the achievements of a Siemens. Does any one suppose that these involve the intellectual labor performed by the average tyro struggling to overcome some petty difficulty? Great results have unquestionably been achieved by enforced attention and patient labor, but the greatest achievements arise by unconscious reflex action of the brain to the stimulus of inherited memories which evolves the idea before it even rises into consciousness. It is precisely this clearness of perception and facility of execution, recognized as genius in man, which characterize the special labors of insects and other of the lower animals in their special narrow fields. Further, all naturalists who have given close study to the hymenoptera, for instance, will, I think, support me in the conclusion that the automatic facility displayed in their special tasks is accompanied with intellectual resources which enable them to deal intelligently with emergencies which may arise in the course of their performance.

We may find a still closer parallelism between man and the lower animals in the matter both of inherited perceptions and capacities of performance on a lower intellectual plane, which being part of every man's experience, the relation of inherited to acquired ability will be the more readily appreciated. Every child knows intuitively that an apple is good to eat. On this point his perceptions are clear, his convictions not to be shaken. This is a familiar instance of inherited perception or brain memory. In fighting we have an illustration of muscle-memory. A fistic encounter calls forth as diversified and complicated a series of activities as almost any species of manual labor, but a ten-year-old boy of fighting stock will stand up to his first fight and play his part with a skill and address and promptitude such as he could not acquire in any industrial pursuit without considerable training.

These are only particular illustrations of a well-known general law. Any muscular or mental labor long persisted in is attended with a facility of execution which in time becomes constitutional in the race. Man is immeasurably removed from the lower animals by his wider range of perceptions and capacities, but we cannot form a better idea of the intellectual status of the lower animals, within their narrow limits, than by speculating on a future ideal stage of human evolution, when every child born into the world will, as his intellect unfolds, display, without instruction, the mathematical genius of a Euclid, the musical powers of a Mozart, the logical powers of a Bacon, and the comprehension of character of a Shakespeare.

THE DATE OF THE LAST GLACIAL EPOCH.

BY MAJOR-GENERAL I. C. COWELL, WINDSOR, ENGLAND.

NOW that the untiring labors and vast research of such men as Professors Wright, Prestwich, and Emerson, Dr. Andrews, and Messrs. Gilbert and D. Mackintosh have resulted in such remarkable coincidences as to the period of the termination of the last glacial epoch, England, as America, may well be congratulated upon such achievements by their men of science in that intensely interesting field of enquiry; but our satisfaction would be far from complete if we did not find confirmation of these results in those of astronomical discovery, which give evidence of that perfect harmony which has so long been sought for in vain by astronomers and geologists and by all those who have awaited the revelation which unquestioned facts have at last disclosed. These are to be found in the beautiful discovery of Major-General Drayson of the Royal Artillery (formerly professor of astronomy at the Royal Military Academy at Woolwich) of the second rotation of the earth, whose works, entitled "30,000 Years of the Earth's Past History" and "Untrodden Ground in Astronomy and Geology" (published by Chapman & Hall and by Paul, Trübner & Co. of London), afford the most striking testimony to the accuracy of the calculations of the gentlemen referred to.

In so short a notice as this it is only possible to give a general outline of the discovery, which has occupied nearly thirty years for its full development, resulting in the discovery that the glacial period, or, more properly speaking, periods, occupy about 20,000 years, whilst the last terminated about 6,000 years ago. This, however, is but one of the results of the discovery.

The earth has three principal movements, the first being its daily rotation, the second the annual revolution of the earth round the sun, and the third a slow second rotation of the earth which causes the half axes of daily rotation to trace cones during a period of about 31,600 years.

The second rotation, more accurately defined, consists in the pole of the heavens describing a circle round a point, which is ascertained to be situated six degrees distant from the pole of the ecliptic, having a right ascension of 270 degrees, and at an angular distance from the pole of the heavens of 29° 25′ 47″, this angle depending upon the position of the centre of gravity of the earth, the earth being considered as a gyrating sphere, and so following the ordinary laws of gyration.

The two semi-axes of the earth by this movement describe cones, having their apices at the centre of gravity, which in the case of the earth nearly corresponds to the centre of the sphere. From the knowledge of this law, and from these data, the polar distance of a star can be at once calculated for more than a hundred years from one observation only, and to the decimal of a second of an arc, a result which hitherto could only be attained by constant observation and laborious calculations by the method adopted by astronomers in ignorance of the properties of this rotation.

The obliquity of the ecliptic can be ascertained for any time during the revolution of the poles, which are calculated to occupy 31,682 years in completing the circle. Hitherto the time supposed for the completion of this conical motion was about 25,000 years, during which period scarcely any variation occurred — so it was asserted — in the extent of the Arctic circles and tropics.

By a knowledge of the second rotation it is proved that a variation of twelve degrees in the extent of the Arctic Circle and tropics occurred not later than 13,500 B.C. The procession of the equinoxes is ascertained to be the result of this second rotation, and due to no other cause; and the rate of procession can be ascertained at any time, this, it may be mentioned, being proportionate to the sine of the obliquity of the ecliptic at the time indicated, in its every-varying amount from the minimum of 23° 25′ 47″ to the maximum of 35° 25′ 47″.

With such a difference, it follows that at the height of the glacial period — that is, when the obliquity attains to 35° 25′ 47″ — the Arctic Circle will have crept down towards the equator in both hemispheres twelve degrees, which will thus cause the tropics to extend to the same amount towards the poles, and so extend the tropical zone from Cape Hatteras to the River Plate.

Under such conditions the human mind fails to conceive the vast changes which must be brought about during every six months from the mighty floods caused by the intense summer heat and the intense cold of the Arctic winter, alternating with each other.

It is to such changes of temperature that we find the remains of Arctic and tropical animals imbedded together in the same